The facts are these: An aqueous solution of carbolic acid (1 to 5 per cent.), if applied to an extremity, as the fingers or toes, for a number of hours in the form of a moist dressing or poultice, may produce gangrene and total destruction of the part. This result is not from compression, but simply from the action of the carbolic acid.

The following history of a case illustrates the occurrence:

The patient came to the out-patient department of the Massachusetts General Hospital. A delicate girl, aged twenty-six years, cut the tip of her right index finger with a piece of tin. Her brother, a strong, healthy man, had treated a cut finger two weeks before with a solution of carbolic acid which he had bought from an apothecary. His cut healed quickly and without trouble of any sort. She adopted the same treatment, washed the finger with the same solution and put on a bandage which she saturated with the carbolic solution. This was 6 P.M. On going to bed she moistened the dressing again with the solution. There was some pain in the finger during the night. In the morning on removing the dressing the skin of the finger was gray in color and the finger felt "lifeless and heavy." It was somewhat swollen throughout and especially at the base. The color changed in a few hours to a dark brown. The discoloration was general, and extended nearly to the base of the finger, this being the limit of the bandage.

A poultice of flaxseed meal was applied. The numbness remained. When the finger was allowed to become dry it looked quite black. Various dressings of a soothing nature were applied.

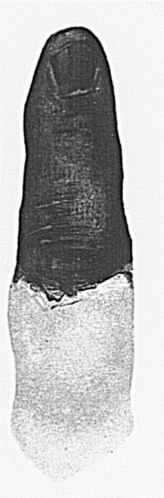
At the end of four weeks, when I first saw the finger, it appeared to be in a condition of advanced gangrene. (See Plate I.) It was clay-colored in places, dark brown in some, and black in others. The nail appeared bluish-black. A well-marked "line of demarcation" had formed near the end of the first phalanx. The superficial tissues of the remainder of the phalanx were reddened and swollen. The finger was amputated at the middle of the first phalanx. Dr. William F. Whitney made the following report upon the microscopical appearance of this amputated finger:

"A transverse section was made completely through the finger after removal of the bone. This was mounted in celloidin and stained with polychrome methylene-blue and eosin. The skin and subcutaneous tissue stained diffusely with the exception of numerous large colonies of micrococci, which were found in the breaks on the surface and could be followed into the deeper layers. The vessels in this area were thrombosed, and colonies of bacteria were present in the blood-clot. Separating this from the deeper layer was a wide zone of round-cell infiltration, among which polynuclear leucocytes were present in large numbers. In places the tissue was liquefied, and there was a distinct formation of pus. From this to the periosteum there was a diffuse infiltration of round cells, and many of the small vessels were thrombosed, with areas of hemorrhage among the tissues.

"The process may be regarded as a total superficial necrosis with deeper purulent inflammation and hemorrhage." (See Plate II.)

This record is so like the history of other cases observed in the out-patient department of the Massachusetts General Hospital that a report of them would be a needless repetition.

PLATE I.



CARBOLIC GANGRENE.

Appearance of a finger four weeks after the application for twenty-four hours of a dilute solution of carbolic acid. The finger was wrapped in cloths which were saturated with the carbolic solution not stronger than five per cent. Amputation necessary. Inflammatory process at the base of the finger shown by the reddened tissues.

Microscopic appearance shown in Plate II.

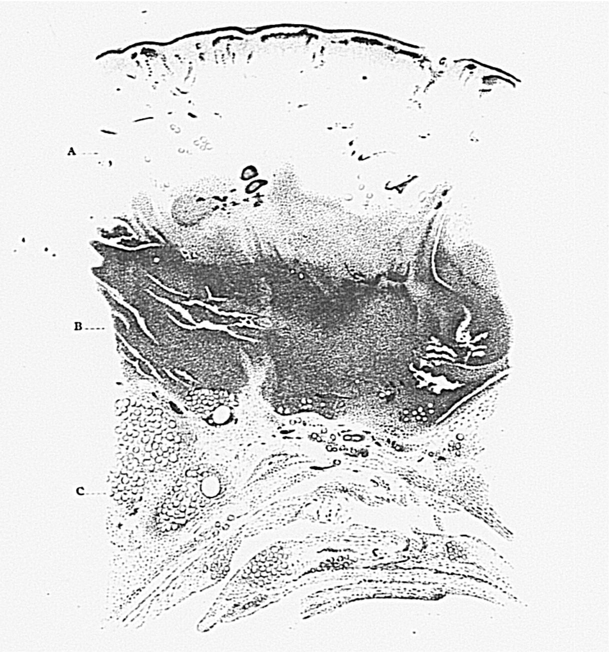
The history of the reported cases varies but little. The patient suffers from a wound or pain in the extremity, and by advice, sometimes unhappily, of a physician, sometimes of a friend, and often because of his own idea of the proper treatment of such conditions, he purchases from a pharmacist a solution of carbolic acid. The member is wrapped with a dressing saturated with the solution. If the solution is strong enough and the length of time of its application is long enough the result will be a loss of the part. It is sometimes impossible to determine the exact strength of the solution which has been used. It is safe to assume that it is not stronger than a 5 per cent. solution, since water, which is the common solvent, will take up only about 5 per cent. of the acid. Numerous cases (Lévai[33] and others) have been reported in which 3 per cent. and 2 per cent. solutions have caused gangrene which has resulted in amputation.

Péraire[41] reports a case in a child of ten years, who lost the second and third joints of the finger after twenty-four hours of exposure to a compress saturated with a 1 per cent. solution of carbolic acid. It is therefore plain that any solution of carbolic acid between 1 and 5 per cent. is dangerous. It is needless to add that gangrene does not always follow the use of carbolic solutions in this manner. In the report of the case occurring at the Massachusetts General Hospital, which I have given in detail, I mentioned the fact that the brother of the girl who lost her finger by carbolic gangrene had previously used the same solution in the same manner with no bad effect. The result depends on the strength of the carbolic solution, the manner of application, the length of time of application, and the power of resistance of the individual.

The method of application usually employed is to wrap the finger or the toe in cloth and to saturate this with the solution. Usually, in the cases reported, these wrappings have been kept saturated for from twelve to twenty-four hours. It is probable that the strength of the solution has less to do with the unfortunate result than the length of the application and the thickness of the individual's epidermis. Women made up four-fifths of the cases appearing at the Massachusetts General Hospital.

The destructive effect of pure carbolic acid is generally recognized, and sufferers from the cause are now rarely seen, except as the result of accident. Moreover, the injury from pure carbolic acid is usually less serious than from weak solutions. The action of weak solutions is insidious. The injury is done without causing suffering. Strong carbolic acid, as Lévai[33] has pointed out, forms a scab which resists penetration of the carbolic into the deeper tissues, so that complete gangrene and destruction of an extremity are less likely to follow from the use of liquefied carbolic acid than from weak solutions.

PLATE II.



CARBOLIC-ACID NECROSIS. Low power.

A. Area of total necrosis (diffuse red staining) with numerous colonies of micrococci (dark blue).

B. Area of purulent infiltration, diffuse finely granular blue staining from the large number of cells.

C. Area of round-cell infiltration. Fat and fibrous tissue with abundant cells and thrombosed vessels in outer zone.

See Plate I.

"The histological examination shows that in the beginning each of the diluted chemicals applied in the form of a moist dressing produces the same effect: the epithelial layer becomes œdematous and loosened." "As soon as a way has been made to the deeper layers each agent produces in a different way the same result, namely, necrosis of the living tissues." The death of the part takes place in layers downward, and affects not only the nerves and vessels, but all the tissues at the same time. Maceration of the skin having taken place, as a result of prolonged action of the watery solution, the penetration of the chemical becomes easy and rapid.

Experiments and observations show that the gangrene does not result primarily from tight bandages, although tight bandaging undoubtedly increases the tendency to this process. The gangrene is limited to the parts enveloped by the moist compress, for in some cases, as mentioned by Lévai,[23] the last phalanx of the finger when not covered by the dressing has escaped and may continue to have its natural appearance and to bleed when pricked for some time, when the finger nearer the trunk may be quite black and without sensation. The gangrenous process may sometimes be so slight that only the skin is destroyed. Dr. C. A. Porter was able in such a case to save in part the usefulness of a finger by skin grafting before cicatrization took place. The treatment of this condition must vary according to severity of the process. In many cases it soon becomes evident that amputation will be the only helpful treatment. If the process seems superficial and the case is seen soon after the removal of the carbolic dressing it might be beneficial to apply a dressing saturated with a bland alkaline solution such as lime-water.

It has been asked why gangrene does not occur upon the trunk. Superficial gangrene does occur if the application is sufficiently prolonged and the saturation of dressings is great enough. The result is not so disastrous because of the greater thickness of tissues and because the blood-supply cannot be shut off as it is in an extremity. It is the enveloping of the entire part, as a finger or toe, with the dressing which causes the complete destruction of the part, since the gangrene only affects those parts which are thus covered.

The public must be taught to use some safer treatment. Moist dressings are often very soothing and helpful in slight injuries of the fingers or toes. A large part of the benefit to be derived from any form of moist dressing can be obtained by using boiled water on clean compresses. Safe household remedies for this purpose are tincture of hamamelis or solutions of borax or of boric acid.

It is evident that carbolic acid solutions in any strength applied as a moist dressing is dangerous and ought never to be used. The fact that it is often used without bad results renders it the more dangerous. It is the duty of the medical profession to see that this needless destruction of fingers is stopped. Carbolic acid of any strength should be included in the list of those drugs which can only be procured by a physician's prescription. Whatever the strength, it should always be labelled as dangerous.

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REPORT OF THE COMMITTEE OF THE AMERICAN SURGICAL ASSOCIATION ON THE MEDICO-LEGAL RELATIONS OF THE X-RAYS.[1]

GENTLEMEN: At the meeting in 1897, in a paper on the "Röntgen Rays in Surgery," the chairman of this committee made the following remarks:

"Before leaving the subject of fractures it may be well to present for discussion a few questions having a medico-legal bearing, even although it may not be possible at present to answer them finally.

"We may begin by asking whether skiagraphy has as yet given us a better understanding of fractures in general or has been the means of suggesting more efficient treatment.

"It is difficult, in reply, to point to any one definite addition to our knowledge of these injuries, and so far as I know no material modification of the general rules governing the treatment either of fractures generally or of any specific fracture has as yet resulted; but in individual cases, such as have been described above, it has certainly been of great utility, and is likely to become more valuable as technique improves and experience increases.

"The question whether or not the patient has the right to demand, as ordinary care, that the medical attendant should have a skiagraph of the fracture taken, I would at this time unhesitatingly answer in the negative. Until a much larger number of cases have been observed, and the pictures and the clinical results have been compared, the routine use of skiagraphy might be more harmful than useful.

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[1] Read by the Chairman of the Committee, Dr. J. William White, of Philadelphia, at the meeting, May, 1900.